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### INJURY TO VEGETATION RESULTING FROM CLIMATIC CONDITIONS.<sup>1</sup>

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Nearly every winter furnishes conditions which are responsible for more or less injury to vegetation of both native and exotic species. During the past decade a vast amount of damage due to extreme conditions has resulted to vegetation, especially in the northeastern States. There has probably been no period within the memory of living men, or for that matter within the period of exact meteorological records, when damage to vegetation in America has been more extensive than during the past 12 years or since the winter of 1904. Every meteorological factor has its specific influence on vegetation, but since some of these influences are so intimately related to certain types of injury we will [sic] deal only with those concerned in the so-called winter injury. The principal meteorological factors associated with winter-killing and allied phenomena are temperature, soil and air moisture, wind, and light.

Either high or low temperatures or too much or too little soil moisture are conducive to abnormal conditions in plants; also the amount and intensity of light and the movements of the air form important factors in respect to this. Both winds and sunlight have a marked effect on transpiration, even sunlight alone greatly accelerating this process. Therefore, for a correct understanding of the cause underlying injury to vegetation from climatic conditions, it is essential to have some conception of the relative importance of meteorological agencies on plant development and the rôle which they play in regard to susceptibility to various troubles.

Some of the conditions which underlie winter-killing are as follows:

Severe and prolonged cold, causing frost to penetrate to a great depth.

Sudden and severe cold following a prolonged warm spell in the Fall, in which case the wood tissue may be tender and immature.

All conditions which favor a soft growth and immaturity of wood. Various causes may be responsible for this, such as growth in a low, moist soil, too heavy manuring or fertilization, or absence of sufficient sunlight.

General low vitality, caused by insect pests and fungous diseases and by lack of moisture in the soil.

Insufficient soil covering, such as lack of organic matter, light mulching and thin snow covering in winter.

Location in unusually windy and exposed places, etc.

A summer drought followed by copious rains during the Fall is often responsible for the production of immature tissue susceptible to cold.

Plants growing in the drainage of cesspools are likely to be affected by cold owing to the production of unripened wood.

Many of our introduced species are quite tender and are likely to be affected more or less every winter by severe cold. The buds of peach trees are generally affected by cold in the northern States and such plants as the privet, Japanese maples, etc., are affected by ordinary cold. On the other hand, plants that are native further north, such as the Labrador tea, frequently suffer some winter injury in our latitude when grown out of their natural environments. Swamp species transplanted to relatively dry soil suffer more from drought and low winter temperatures than those grown in their normal habitat. Many native plants are winter-killed badly when on the north side of buildings where light is insufficient, because in such situations the wood fails to mature properly. On the other hand, some southern species of plants, such as the magnolias, are more hardy in the north than are some of our native species. Indeed the reason why the magnolias do not grow more abundantly in the north is apparently not connected with temperature requirements.

Some injury to vegetation is generally caused by snow and ice, and this aside from that which occurs from the overloading of branches. The leaves of the lower branches of various conifers are often killed when buried in snow banks and the leaves of arbutus are commonly sun-scorched from exposure to winter snows and ice.

The injuries resulting to vegetation induced by meteorological conditions can be conveniently placed under two different categories, namely, injury to the root system and injury to the aerial portion of the plant, to limbs, branches, and leaves. Injuries which occur to a plant above the surface of the ground and which are associated with meteorological agencies are "frost cracks," "sun-scald," "sun-scorch," and "bronzing."

#### FROST-CRACKS.

"Frost-cracks" are formed in winter and are due to extreme changes in temperature within the tissues and occur on those portions of the tree where the maximum amount of heat is developed, namely, on the southwest side of the tree. Since the maximum amount of heat derived from sunshine is received generally between 2 and 3 p. m., that portion of a tree-trunk coinciding with the direct rays of the sun at this period is the one most likely to be affected on a day of uniform clearness. Moreover, the location of frost-cracks on a tree coincides with that area giving the minimum electrical resistance, and since the electrical resistance of a tree is proportional to the temperatures of the tissue comprising the same—the lower electrical resistance corresponding with the higher temperatures—that portion of the tree showing the least electrical resistance is most susceptible to frost-crack.

The opening and closing of frost-cracks are very responsive to changes in the meteorological conditions, they being influenced by variation in temperature, moisture, and in barometric conditions. They open more in winter than in summer, more under a dry than under a moist atmosphere, and more during high than during

<sup>1</sup> Reprinted from *Jour., New York botan. garden*, Oct. 1916, No. 202, 171:173-179.

low barometric pressure. Various fruit and shade trees are susceptible to frost-cracks and the principal injury caused is to induce a tendency to bleeding.

#### SUN-SCALD.

What is called "sun-scauld" is associated with severe and abrupt changes in temperature on non-ripened wood. Sun-scauld may occur either in the winter or in summer. When coniferous forests are thinned and sunshine is allowed to enter, the exposed trees are likely to suffer from sun-scauld. The moose maple, a shade-loving tree, will sun-scauld badly in such a thinned forest or whenever transplanted to the open.

Among shade trees the rock maple is one of the most subject to sun-scauld; also among fruit trees and shrubs various kinds are affected. Sun-scauld is more likely to occur on unpruned apple trees than on pruned ones, or on shaded limbs than on those growing under good light conditions. The shaded limbs on unpruned and neglected apple trees are more likely to be affected by sun-scauld owing to the development of unripened wood. Sun-scauld may also follow as a result of too intensive sunlight, as, for example, when certain fruit trees are stripped of their foliage in the summer, such as sometimes results from the ravages of the gypsy moth. In such instances the new unripened wood sun-scaulds badly.

#### SUN-SCORCH.

"Sun-scorch," a term applied to the burning of foliage, generally occurs in Summer during periods when the soil is dry, and also is common to evergreens during warm windy days in Spring before the frost is out of the ground. Any defects in the root system which prevent root absorption are likely to give rise to sun-scorch. In the case of evergreens sun-scorch is not infrequently ascribed to winter injury and in fact it may follow winter killing of roots. It may be induced by any cause responsible for a defective root system, such as by winter killing of roots, by drought, or by the use of such fertilizers as have an inhibitory effect on root absorption, etc.

Sun-scorch is common to many trees, particularly the rock maple, and is characterized by a burning of the foliage, which often becomes lacerated when strong winds prevail. Since sun-scorch occurs on the side of the tree coinciding with the direction of the prevailing winds, the particular combinations of meteorological conditions which cause this can readily be determined. In one instance when the wind was blowing at the rate of 72 miles an hour from the northwest during May, at a time when the soil was relatively dry and the leaves exceptionally tender, practically all of the foliage of the rock maples over a large section was sun-scorched on the northwest side of the trees. During another severe dry period in Summer, when the wind was blowing at 80 miles an hour, the white pines in southern New England, which were suffering from a defective root system were sun-scorched.

#### BRONZING.

"Bronzing" of foliage is a form of sun-scorch characterized by the occurrence of a reddish-brown or bronze color of the leaf. It is produced by lack of soil moisture or defective root absorption during dry, hot periods. In bronzing, the cells farthest removed from the water-conducting tissues of the veins and veinlets of the leaves collapse from want of water, while those nearest to the water-conducting channels may remain alive. These

groups of dead cells give the leaf the peculiar color from which this type of sun-scauld takes its name. The location of some trees is such that they are subjected to sun-scorch or bronzing during every dry period.

The burning which has occurred so extensively to conifers and evergreens, particularly rhododendrons, during the past Spring comes under the category of sun-scorch. This has occurred frequently through many portions of New England. It has been, however, more severe around New York than farther north and has there affected a large variety of evergreen plants.

We are of the opinion that this burning can be traced to the unusually warm period which occurred between January 21 and 29, 1916, at which time the maximum temperature was 60° F. on the 22d and 70° F. on the 27th. This warm spell was responsible for greatly accelerating the vital processes in plants, and the low temperatures which immediately followed it undoubtedly caused the injury. In some instances the leaves were merely scorched and the terminal buds and wood untouched, while in others the burning was more severe and the wood was injured to such an extent that it died back as the warm weather approached.

This burning appears to have been associated with excessive transpiration or exhalation of water from the leaves at a time when the ground was frozen and the water supply to the roots was insufficient, hence causing a wilting and dying of the foliage and, in instances, of much of the younger wood. Some of the hardier rhododendrons appear to have been burned more than those regarded as tender, and plants under trees seem in many cases to have burned more than those exposed to the direct sun. Generally when spring-burning occurs to evergreens it is associated with more or less strong winds and one side shows the burning more than the other. The injury to foliage and wood occurring to plants during the winter does not always show itself immediately, but is bound to be discernible during March or April when the sunshine is more intense and warm strong winds are likely to occur. It is rather difficult to prevent burning to outdoor plants when unusual and extremely abnormal periods occur in mid-winter. Ordinarily most burning occurring to evergreens during the Spring at a time when the frost is in the ground and warm winds prevail, can be prevented if care is taken to handle the plants properly. Where beds are mulched heavily with leaves it is a good idea to remove this mulching from around the base of the plants as soon as there is a tendency for the frost to disappear. This allows sunlight and heat to enter and thaw out the soil around the plants, which in turn gives an opportunity for the roots to absorb water. After the frost is out of the ground the mulching can be replaced.

The removal of the frost and warming of the soil around the roots of plants by any method which will meet the demands of transpiration, or loss of water from the foliage, will prevent sun-scorching of the young wood and foliage.

#### LASSEN PEAK'S NAME.

U. S. GEOLOGICAL SURVEY PRESS BULLETIN.

[Released October 30, 1916.]

The press dispatches describing the latest eruptions of Lassen Peak show a continued tendency to refer to the volcano as Mount Lassen. *Lassen Peak*, as the most active and interesting volcano in the United States, is specially entitled to be called by its own name, and